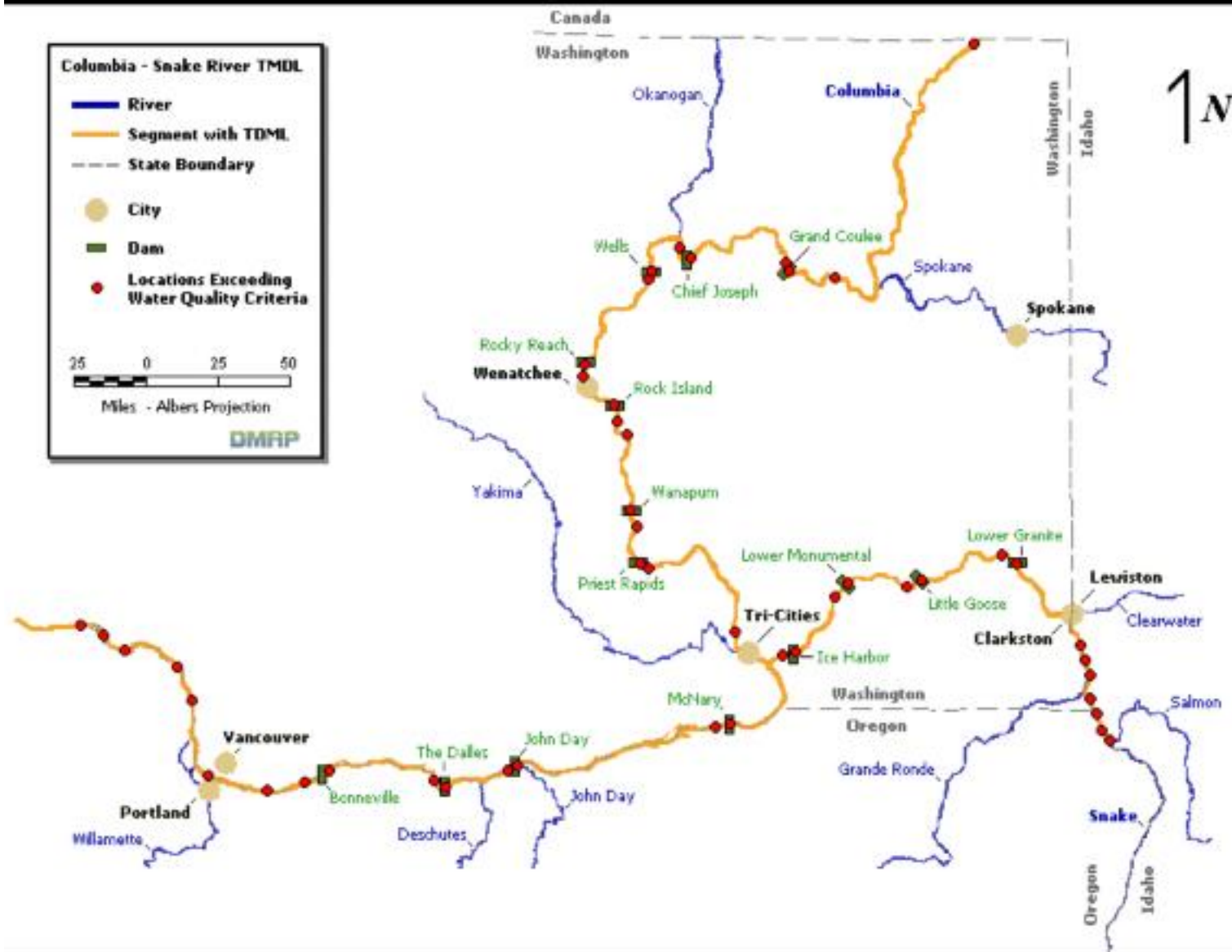


# Columbia/Snake River Temperature TMDL

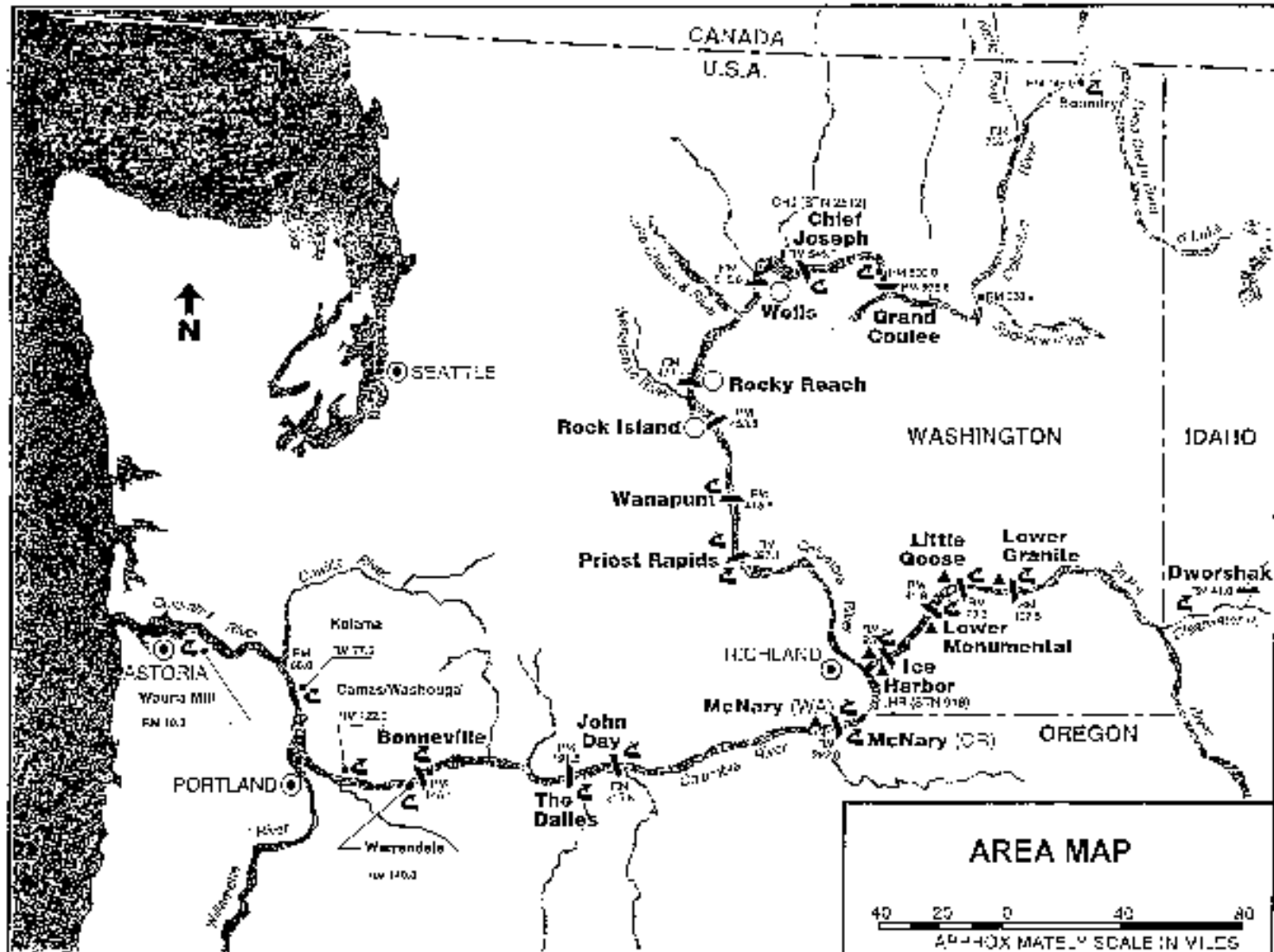
# **What is a TMDL?**

- The amount of a pollutant that a water body can receive and still meet water quality standards.**
- The sum of allowable loads from point and non-point sources, considering seasonal variation and a margin of safety.**
- It determines the sources of pollutants causing or contributing to impairment.**
- It allocates responsibility for reductions needed to achieve water quality standards.**

# Geographic Scope



# Geographic Scope



# **Temperature TMDL Technical Process**

- **Define the numerical targets for the TMDL.**
- **Characterize existing conditions.**
- **Identify sources and evaluate linkages between sources and temperature response of the river.**
- **Quantify loading capacity.**
- **Allocate loads.**

# **Defining the Numerical Targets**

- **The WQS establish the numerical targets for the TMDL.**
- **The WQS for most of the river prohibit or restrict temperature increases due to human activities.**
- **So we have to estimate temperature in the absence of human activity that affects temperature (natural or site potential).**

## Canadian Border

Grand Coulee Dam

Chief Joseph  
Wells

Temperature shall not exceed 16  
Degrees C due to human activities.

WA and Colville WQS

Temperature shall not exceed 18  
Degrees C due to human activities.

WA and  
Colville WQS

Priest Rapids Dam

Temperature shall not exceed 20  
Degrees C due to human activities.

WA WQS

OR/WA Border

Temperature shall not exceed 20  
Degrees C due to human activities.

WA WQS

No measurable surface water  
temperature increase resulting from  
anthropogenic activities is allowed  
when temperatures exceed 20  
degrees centigrade (7 day running  
average of the daily maximums)

OR WQS

Pacific Ocean

## Salmon River

22 Degrees C Maximum  
19 Degrees C Daily Average

ID WQS

No measurable surface water temperature increase resulting from anthropogenic activities is allowed when temperatures exceed 17.8 degrees centigrade from July 1 to Sept 30 and 12.8 Degrees C from Oct 1 to June 30.

OR WQS

## OR/WA/ID Border

22 Degrees C Maximum  
19 Degrees C Daily Average

ID WQS

Temperature shall not exceed 20  
Degrees C due to human activities.

WA WQS

## WA/ID Border

Temperature shall not exceed 20  
Degrees C due to human Activities.

WA WQS

## Columbia River

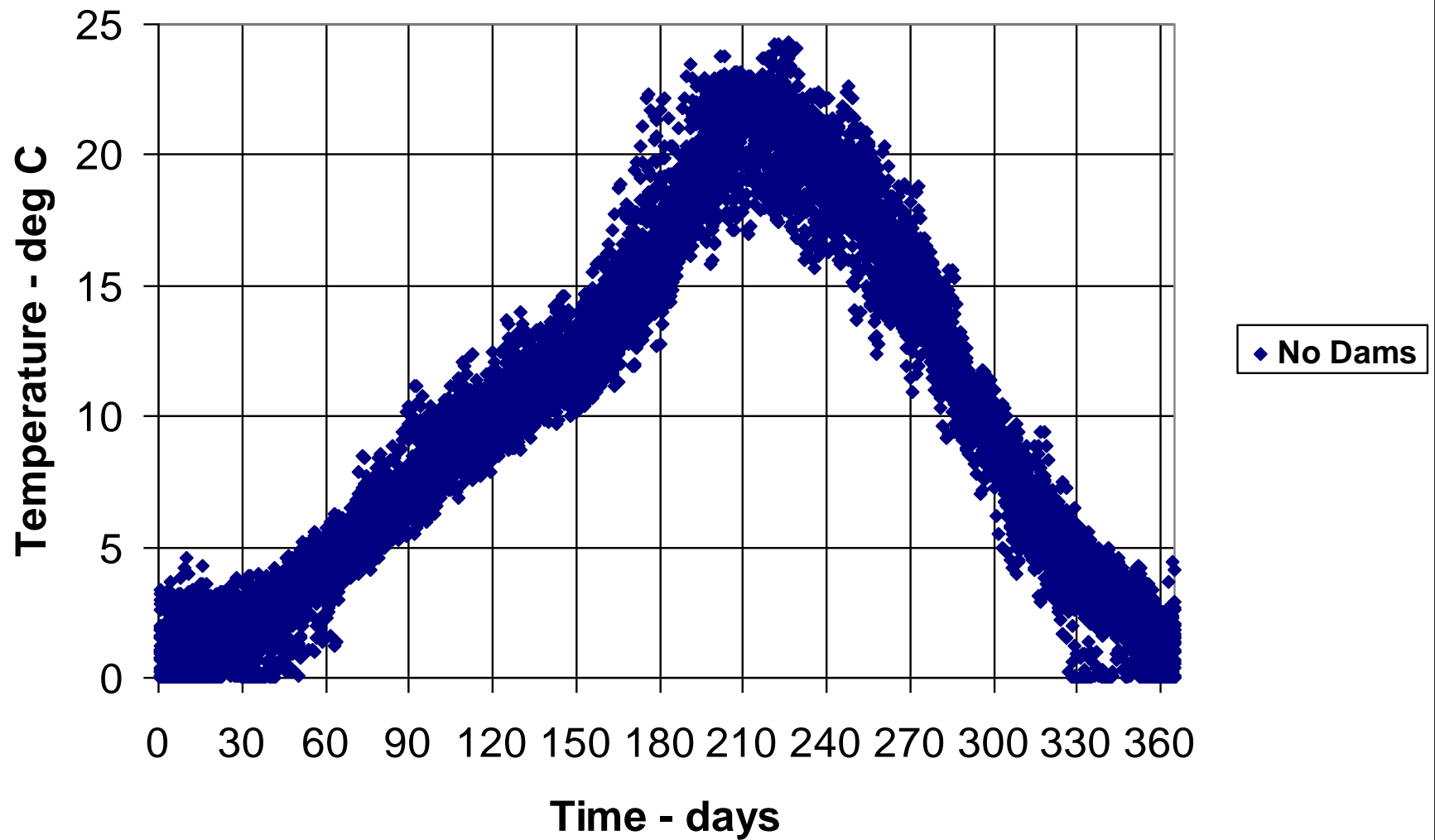
## **Defining Numerical Targets**

- **When natural conditions exceed the criteria in the WQS, the natural or site potential temperatures will be used to establish the numerical targets for the TMDL.**

## **Defining Numerical Targets**

- **Use RBM 10 Water Quality Model to simulate the average temperature of cross sections of the river.**
- **Simulate 30 years of water temperature using existing meteorological and hydrological data.**

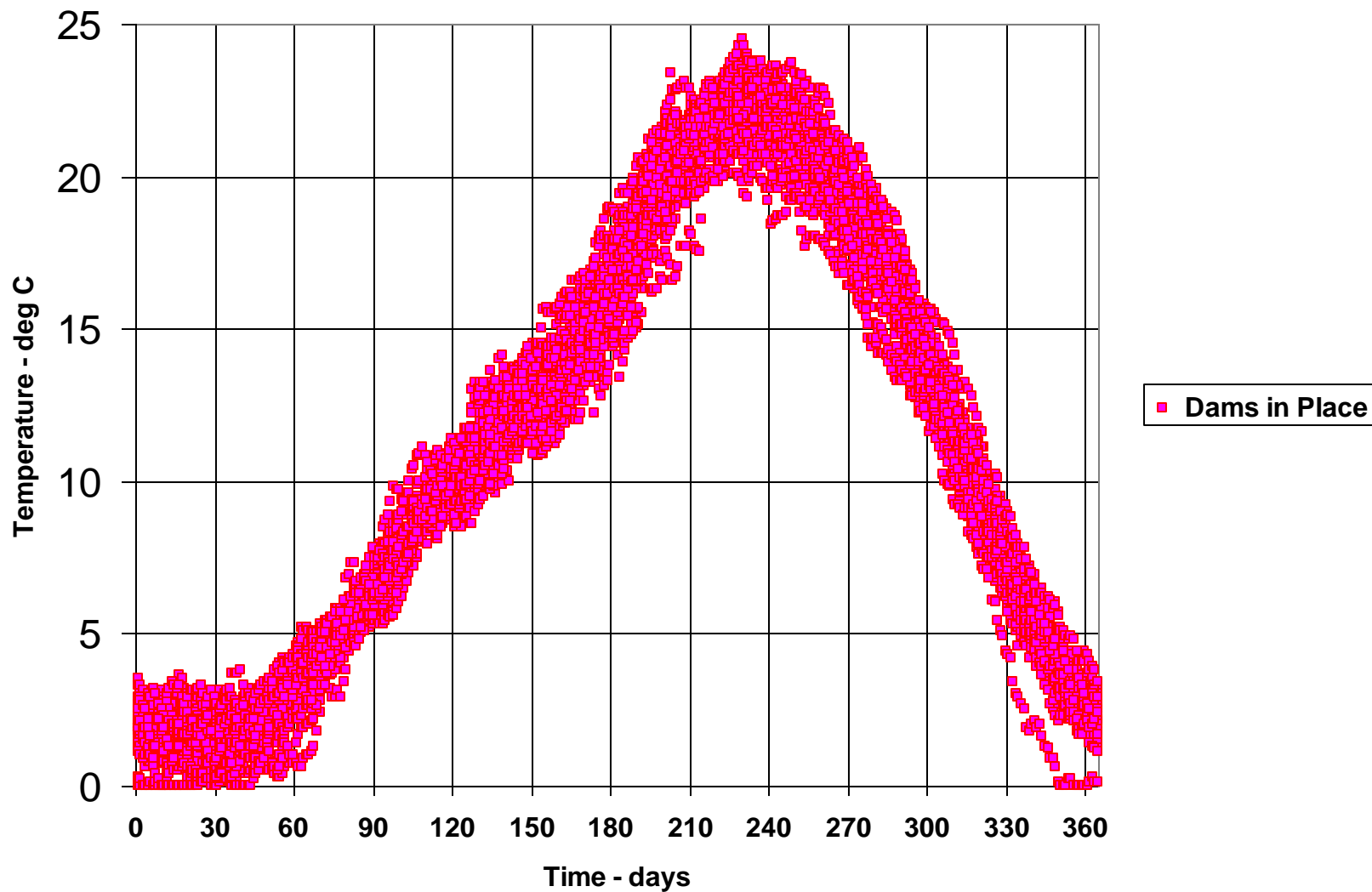
# Simulations of Water Temperatures at Ice Harbor Dam 1970-1999 with No Dams in Place



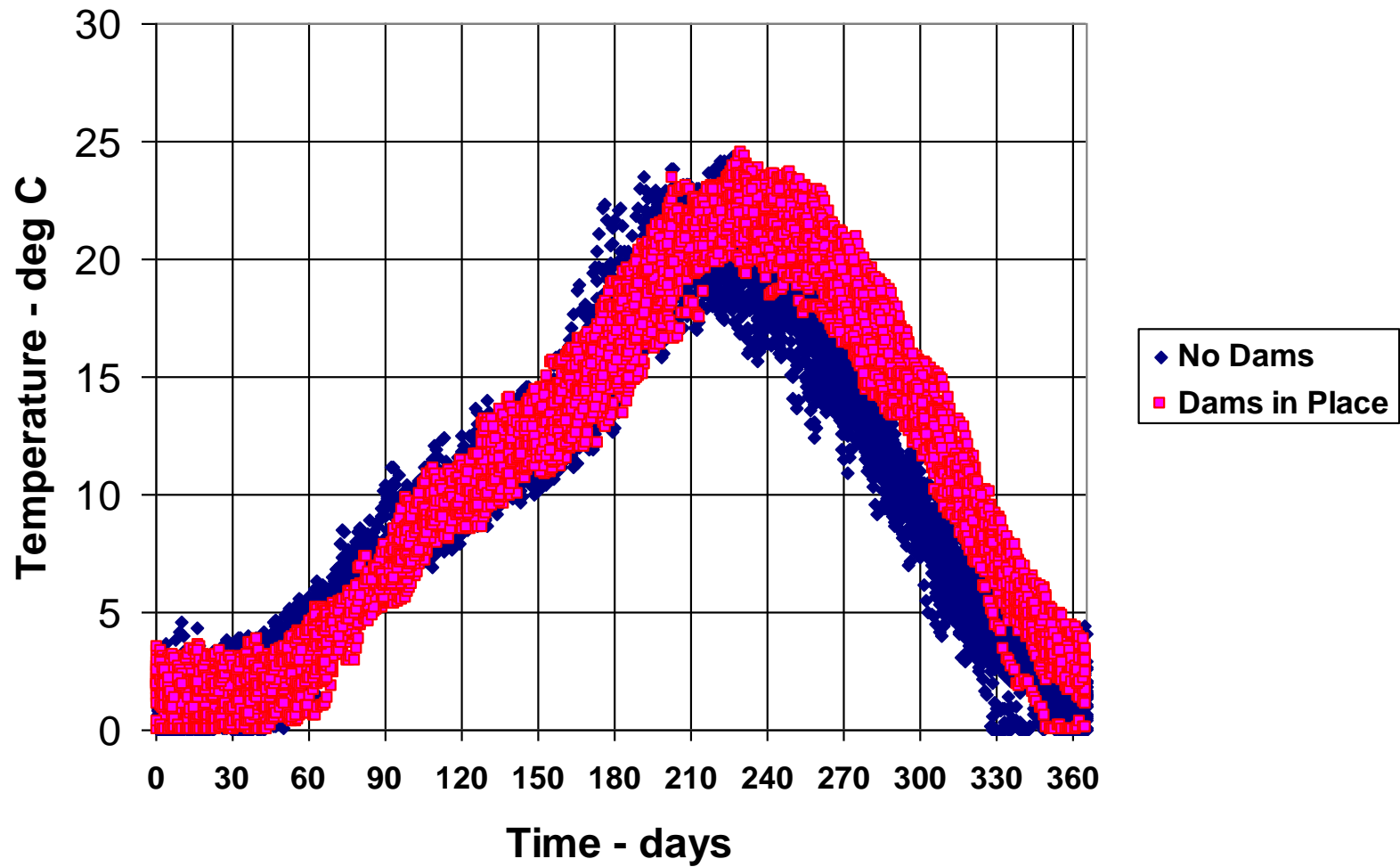
# **Characterization of Existing Conditions**

- **Use the RBM-10 Model to simulate existing conditions.**
  - **Compare apples to apples**
  - **Fill in data gaps**

**Simulations of Water Temperatures at Ice Harbor Dam 1970-1999**



**Simulations of Water Temperature at Ice Harbor Dam 1970-1999**



# **Identify and Evaluate Heat Sources or other Causes of Increased Temperature**

- **Point Sources**
- **Dams**
- **Tributaries**
- **Irrigation Return Flows**

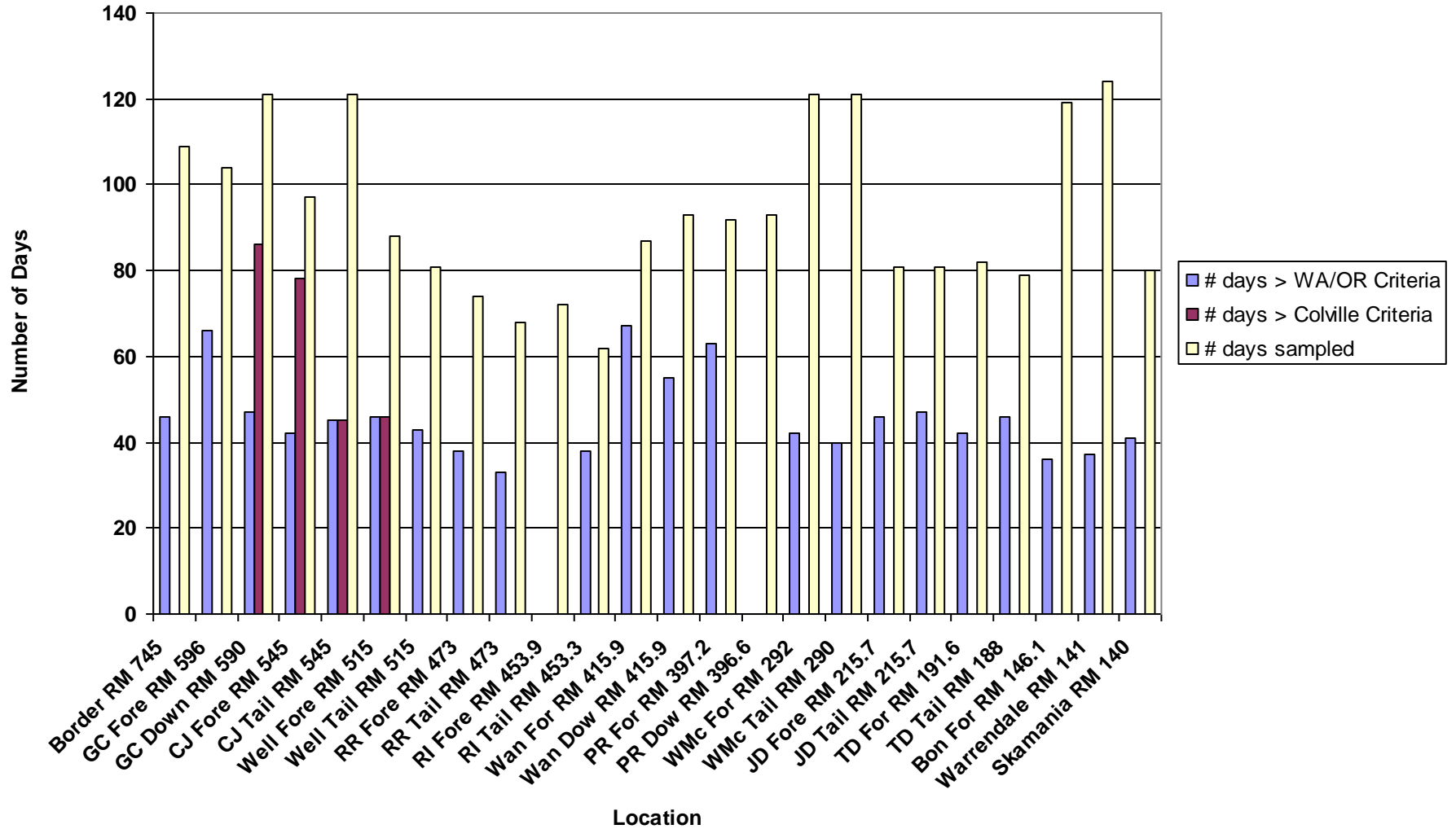
# **Quantify Loading Capacity**

- **Use the loads from the RBM10 simulations of natural or site potential conditions.**

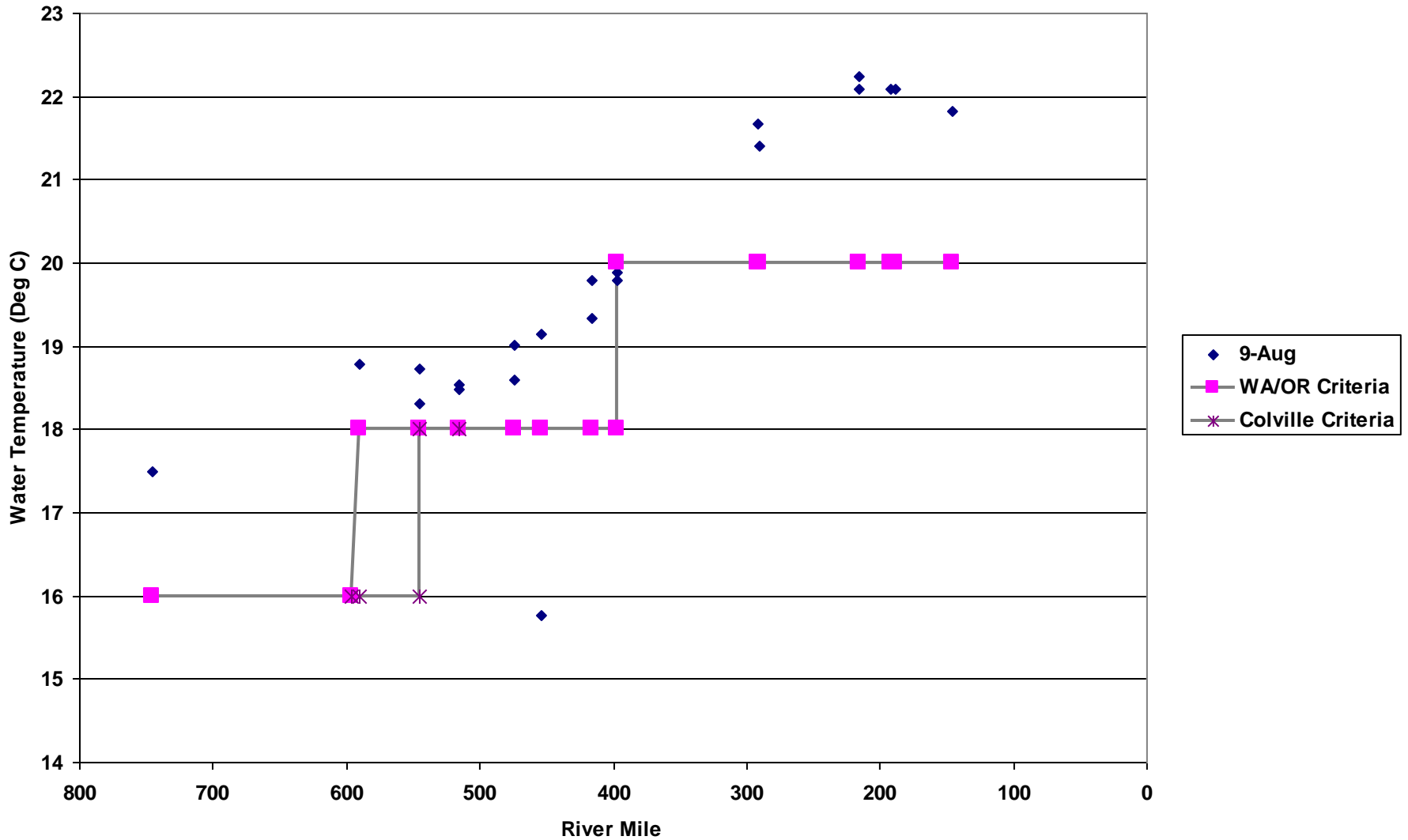
## **Allocate Loads**

- **Use RBM10 for “far field” Waste Load Allocations**
- **Further adjust loads if necessary to achieve WQS at the edge of the mixing zone.**

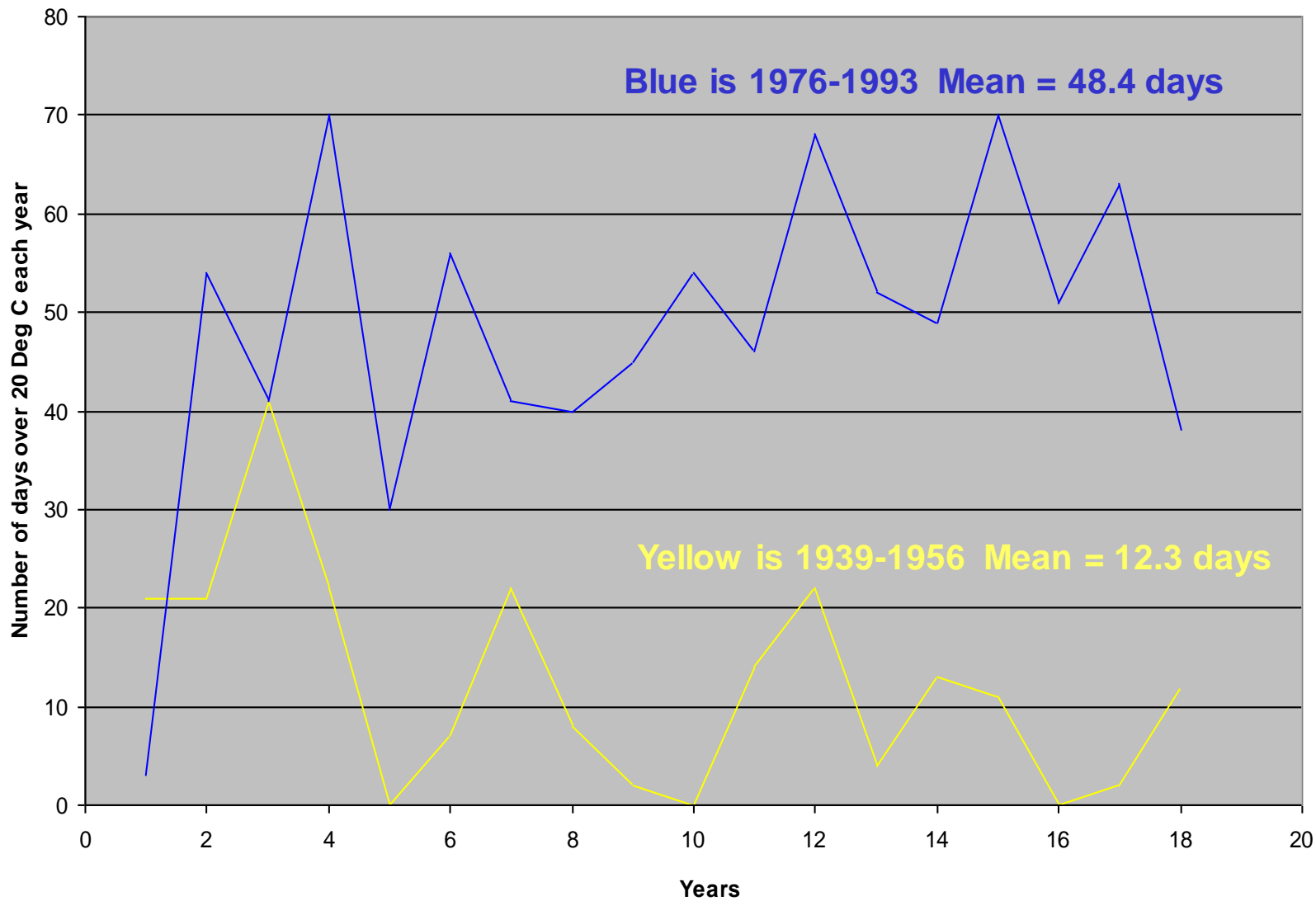
# July Through October, 2000 - Number of Days during which Water Temperature along the Columbia River Exceeded Water Quality Criteria



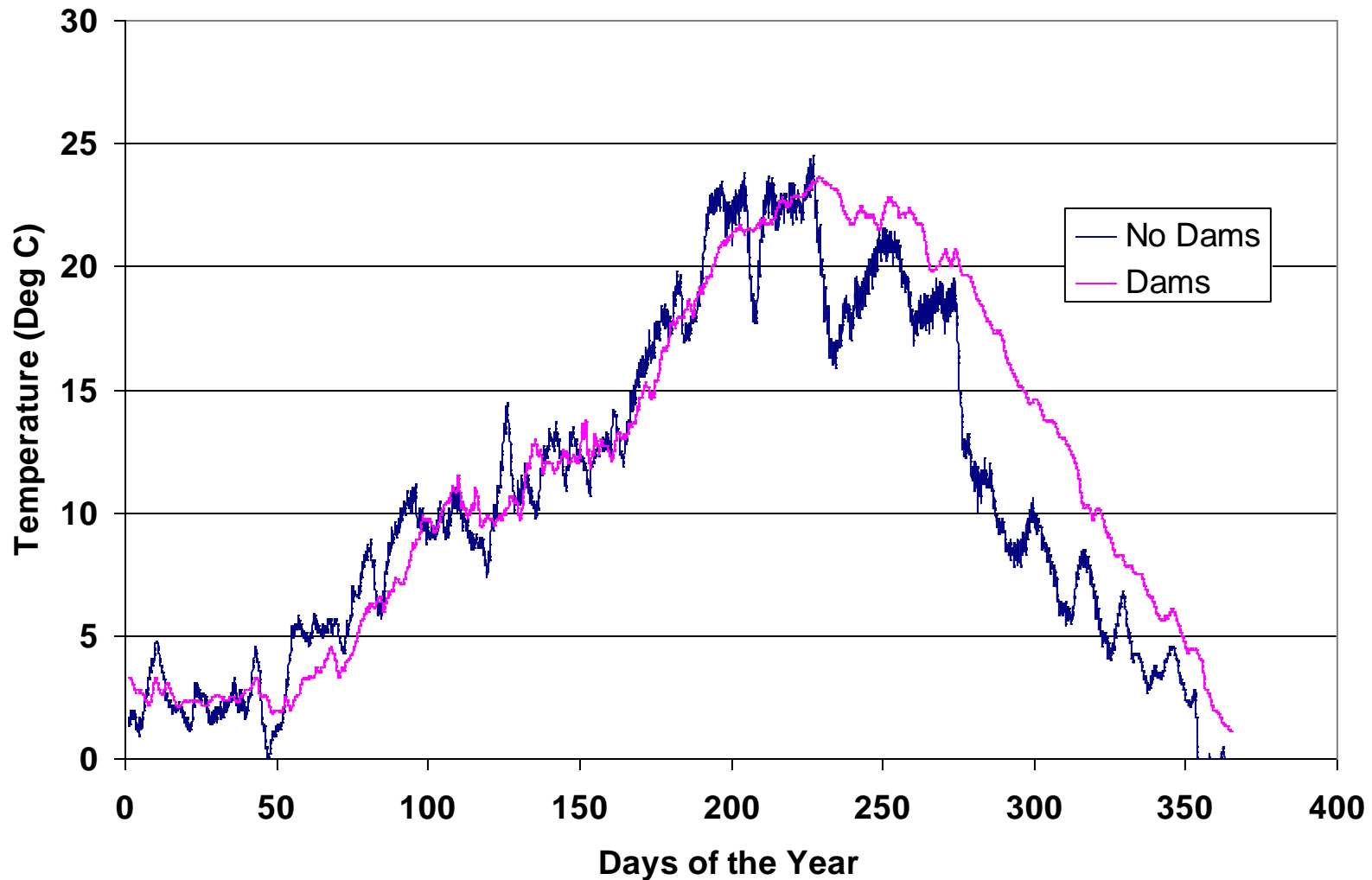
Water Temperature Along the Columbia River on August 9, 2000



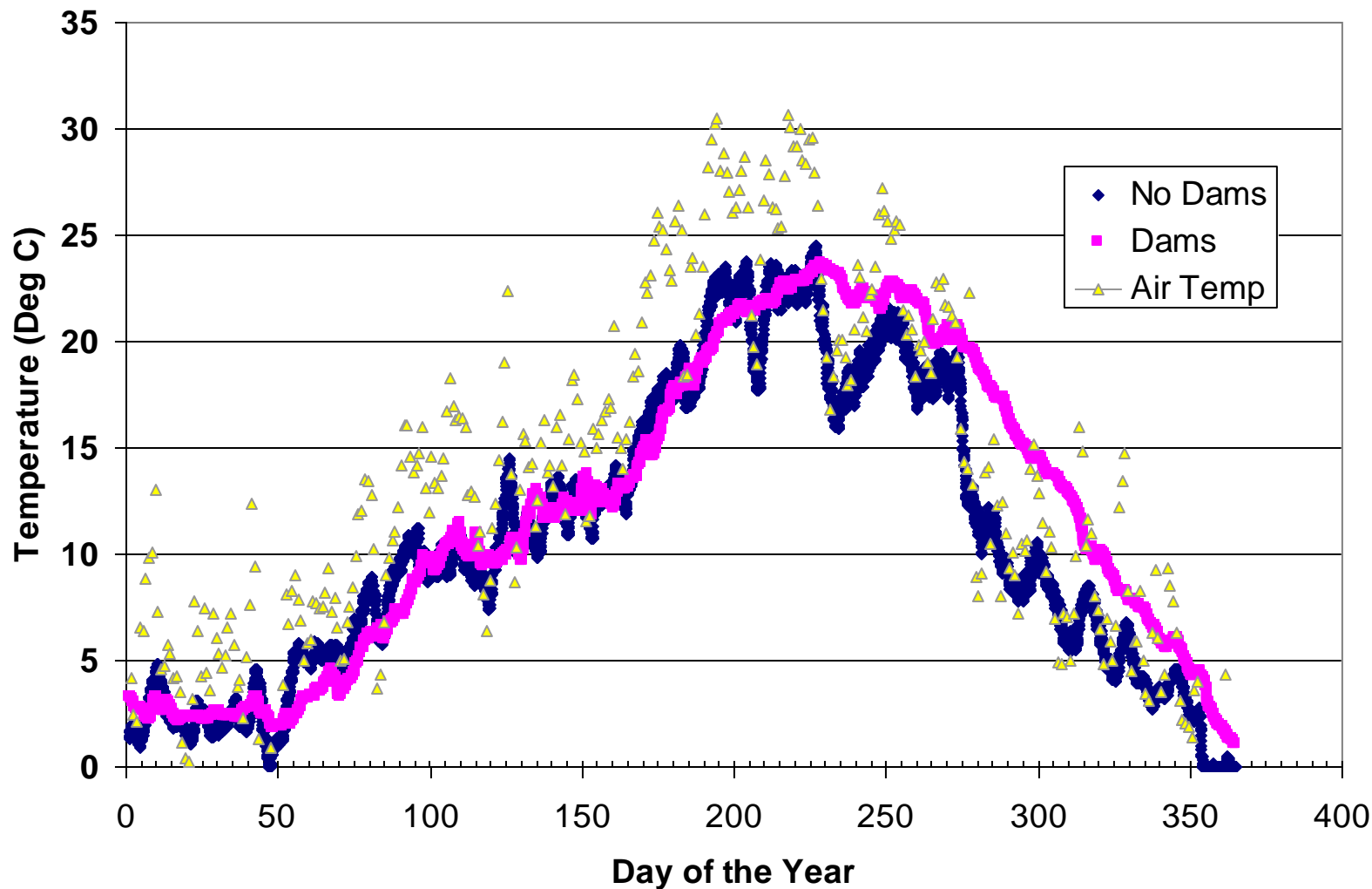
**Number of Days that Exceed 20 Deg C at Bonneville Dam: Comparison of the two periods  
1939-1956 and 1976-1993**



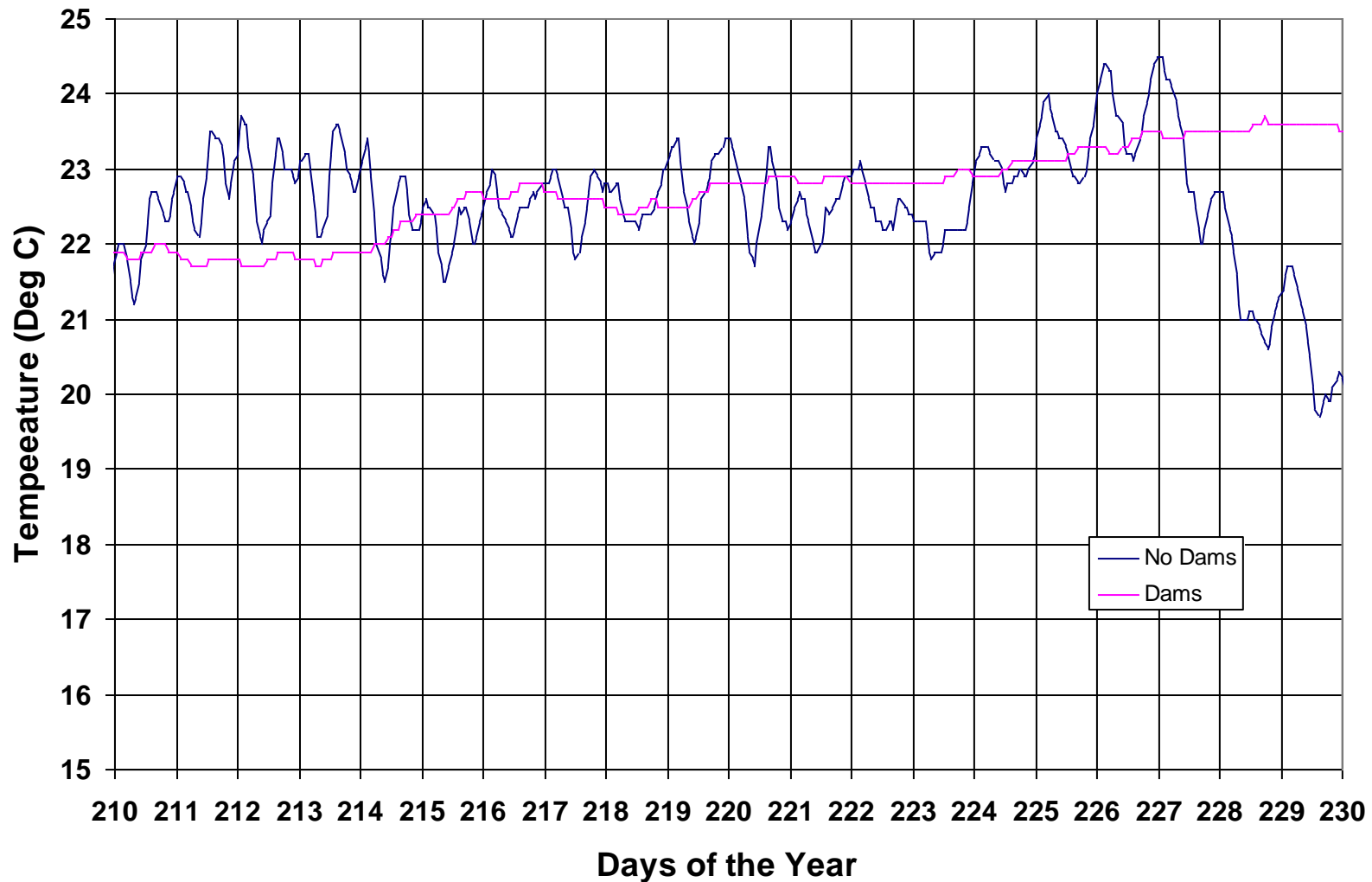
**Figure 3-12. Simulated Water Temperature at Ice harbor Dam 1990 - Dams in Place and Dams Removed**



# Simulations of Water Temperature at Ice Harbor Dam 1990 with Dams in Place and Dams Removed Compared to Air Temperature at Lewiston, ID



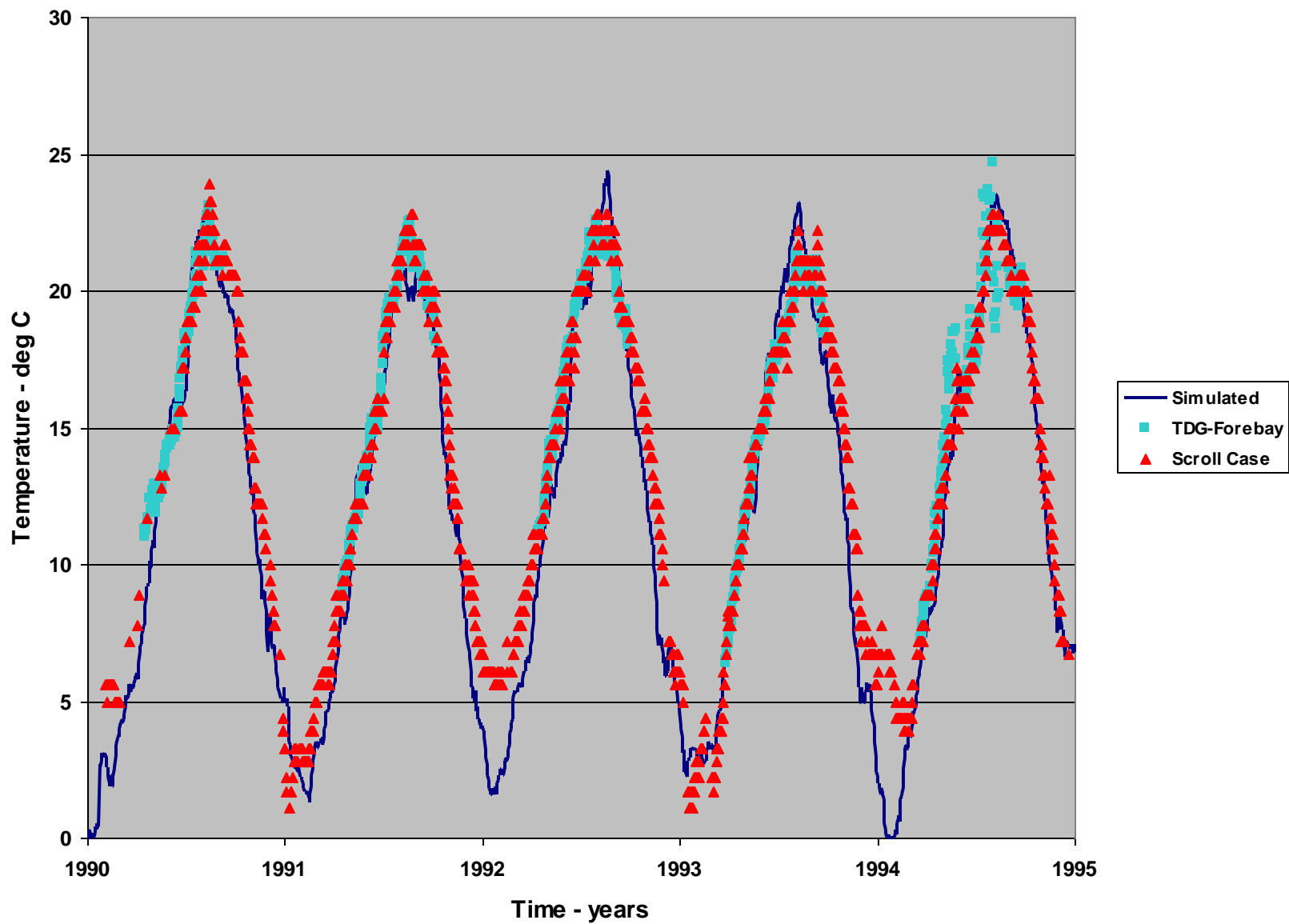
## Simulated Water Temperature at Ice Harbor Dam 1990 - Dams in Place and Dams Removed



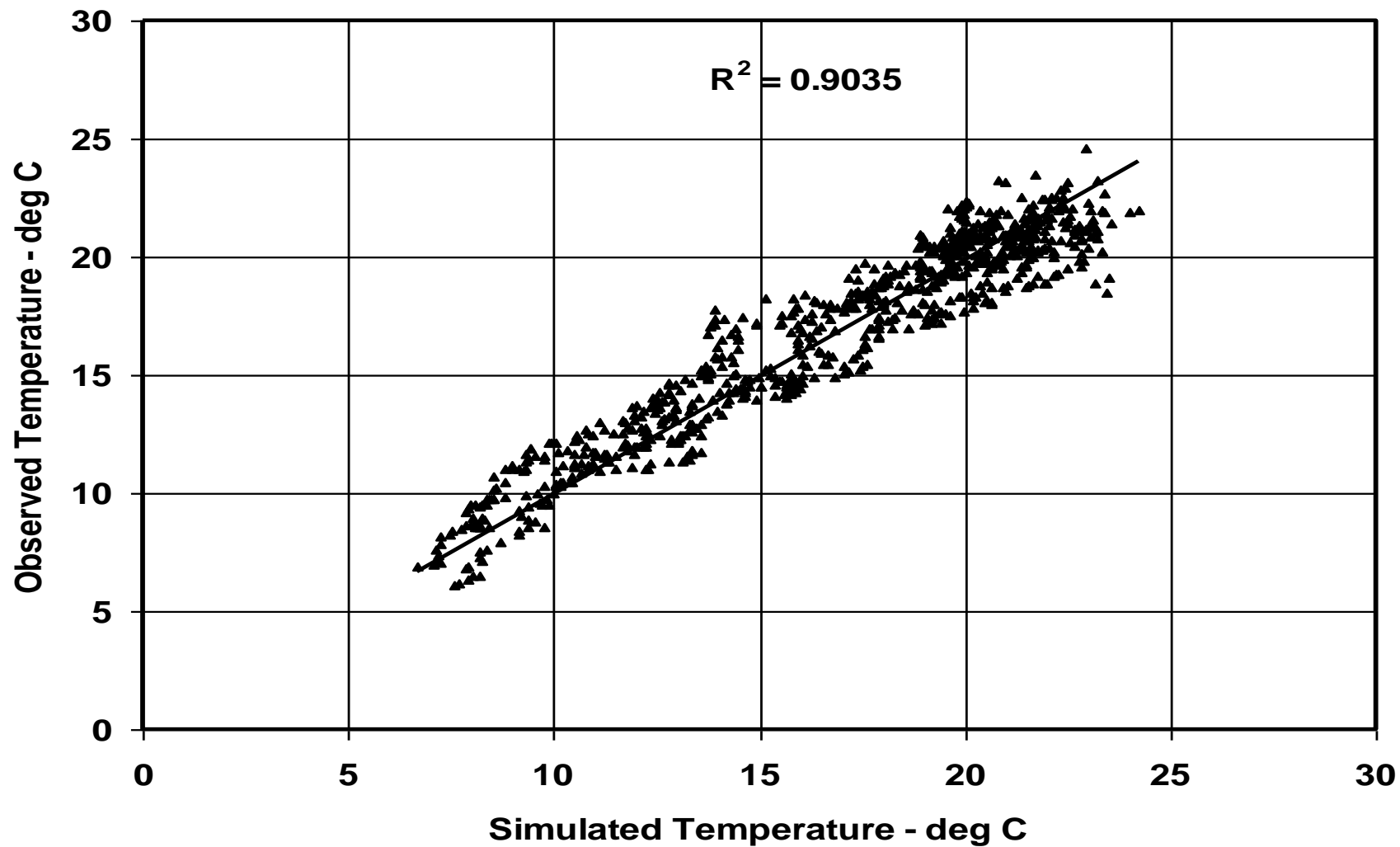
# **How has the Temperature Regime of the River Changed?**

- **Longer periods with temperatures in the warm range for coldwater biota;**
- **Temperature gradients in the reservoirs resulting in warm surface water;**
- **Less fluctuation in temperature - daily and in response to meteorology.**
- **Loss of cold water refugia due to flooding of the alluvial flood plains.**

Simulated and Observed at Bonneville Dam



**Figure D-5. Regression of observed on simulated at Bonneville Dam 1990-1995.**



## RBM10 Results for 1990-1994

| <b><i>Location</i></b>                       | <b><i>Mean<br/>Difference<br/>(Obs-Sim)</i></b> | <b><i>Standard<br/>Deviation</i></b> |
|--|---|--------------------------------------|
| <b><i>Snake River<br/>@Ice Harbor</i></b>    | 0.05 deg C                                      | 1.2                                  |
| <b><i>Columbia River<br/>@Bonneville</i></b> | 0.04 deg C                                      | 1.3                                  |

# Error Estimates from Other Studies

- **RISLEY (1997) - Tualatin River**  
Max Mean Difference = 3 Deg C  
Mostly < 1 Deg C
- **BATTELLE-MASS1 (2001) - Columbia River**  
RMS Error = 0.59 - 1.52 Deg C
- **HDR/PORTLAND STATE/IPC (1999) - Snake River**  
AME = 0.6-2.3 Deg C (1992 data)  
AME = 0.5-2.0 Deg C (1995 data)
- **CHEN (1996) - Grande Ronde River**  
Error = -2.20 - 8.28 Deg C (Summer Max)  
Error = -1.21 - 7.69 Deg C (Avg 7-day Max)